

mud and sand accumulated over the decomposed plant matter, compressing the organic material as the sediments deepened. Over millions of years, sediment layers, known as overburden, exerted tremendous heat and pressure on the underlying plant matter, which eventually became coal.

Before decayed plant material forms coal, the plant material forms a dark organic material known as peat. Although peat will burn when dried, it has a low heating value due to its high water and high moisture content relative to coal. Most of coal's heating value comes from carbon, whereas inorganic materials, such as moisture and minerals, detract from its heating value. For this reason, peat is a less efficient fuel source than coal. Over time, as more sediment accumulates over the peat, this organic material forms lignite, the lowest-grade coal. As the thickening geologic overburden gradually drives moisture from the peat, it increases its fixed carbon content, coal evolves from lignite into successively higher-grade coals: subbituminous coal, bituminous coal, and anthracite. Anthracite, the highest-grade coal, has nearly twice the heating value of lignite (see Heat).

Coal formation began during the Carboniferous Period (known as the first coal age), which spanned 360 million to 290 million years ago. Coal formation continued through the Permian, Triassic, Jurassic, Cretaceous, and Tertiary Periods (known collectively as the second coal age), which spanned 290 million to 1.6 million years ago. Coals formed during the first coal age are older, so they are generally located deeper in Earth. Greater heat and pressures at these depths produce higher-grade coals such as anthracite and bituminous coals. Conversely, coals formed during the second coal age are younger and are generally located at shallower depths. Consequently, coals tend to be lower-grade subbituminous and lignite coals.

## IV COMPONENTS OF COAL

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Coal contains organic (carbon-containing) compounds transformed from plant material. The original plant material was composed of cellulose, the reinforcing material in plant cell walls; lignin, the substance that cements plant cells together; tannins, which are found in leaves and stems; and other organic compounds, such as waxes. In addition to carbon, these organic compounds contain hydrogen, oxygen, nitrogen, and sulfur. After a plant dies and begins to decay on a swamp bottom, hydrocarbons (and smaller amounts of other elements) gradually dissociate from the plant material, increasing its relative carbon content.

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